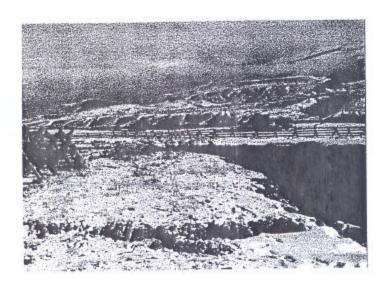
# Lemhi River Watershed TMDL



December 1999

An Allocation of Nonpoint Source Pollutants in the Water Quality Limited Watersheds of the Lemhi River Valley

Idaho Department of Health and Welfare
Division of Environmental Quality
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## **Appendix A. Sediment TMDL Methods and Results**

#### Introduction

This appendix documents the analytical techniques and data used to develop the gross sediment budget and instream sediment measures used in the TMDLs. It describes the methods, data, and results for the following, 1) streambank erosion inventory; 2) gully erosion and mass wasting inventory; and 3) surface and subsurface fine sediment data collection techniques. These data are intended to first characterize the natural and existing condition of the landscape, second estimate the desired level of erosion and sedimentation, and third provide baseline data which can be used in the future to track the effectiveness of TMDL implementation. For example, the streambank erosion and gully inventories can be repeated and ultimately provide an adaptive management or feedback mechanism.

## **Streambank Erosion Inventory**

The streambank erosion inventory used to estimate background and existing streambank erosion followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). Using the direct volume method, sub-sections of 1996 §303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

The NRCS Stream Bank Erosion Inventory is a field based methodology, which measures streambank/channel stability, length of active eroding banks, and bank geometry. The streambank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

#### **Bank Stability:**

Do not appear to be eroding - 0 Erosion evident - 1 Erosion and cracking present - 2 Slumps and clumps sloughing off - 3

### **Bank Condition:**

Some bare bank, few rills, no vegetative overhang - 0 Predominantly bare, some rills, moderate vegetative overhang - 1 Bare, rills, severe vegetative overhang, exposed roots - 2 Bare, rills and gullies, severe vegetative overhang, falling trees - 3

### **Vegetation / Cover On Banks:**

Predominantly perennials or rock-covered - 0

Annuals / perennials mixed or about 40% bare - 1

Annuals or about 70% bare - 2

Predominantly bare - 3

### **Bank / Channel Shape:**

V - Shaped channel, sloped banks - 0

Steep V - Shaped channel, near vertical banks - 1

Vertical Banks, U - Shaped channel - 2

U - Shaped channel, undercut banks, meandering channel - 3

#### **Channel Bottom:**

Channel in bedrock / noneroding - 0

Soil bottom, gravels or cobbles, minor erosion - 1

Silt bottom, evidence of active downcutting - 2

### **Deposition:**

No evidence of recent deposition - 1

Evidence of recent deposits, silt bars - 0

#### **Cumulative Rating**

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year 0.06 - 0.15 feet per year 0.16 - 0.3 feet per year 0.5+ feet per year

Slight

Moderate

Severe

Very Severe

Streambank stability can also be characterized through the following definition and the corresponding streambank erosion condition rating from Bank Stability or Bank Condition above are included in italics.

Streambanks are considered stable if they do not show indications of any of the following features:

- **Breakdown** Obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or False Bank** Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture** A crack is visibly obvious on the bank indicating that the block of bank I about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and Eroding** The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Streambanks are considered covered if they show any of the following features:

- Perennial vegetation ground cover is greater than 50%. Vegetation/Cover Rating 0
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50% of the bank surfaces are protected by rocks of cobble size or larger. Vegetation/Cover Rating 0
- At least 50% of the bank surfaces are protected by logs of 4 inch diameter or larger. *Vegetation/Cover Rating 1*

Streambank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and Burton, 1993). The modification allows for measuring streambank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

- Mostly covered and stable (non-erosional). Streambanks are Over 50% Covered as defined above. Streambanks are Stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 4 (slight erosion) with a corresponding lateral recession rate of 0.01 0.05 feet per year.*
- **Mostly covered and unstable (vulnerable).** Streambanks are Over 50% Covered as defined above. Streambanks are Unstable as defined above. Such banks are typical of ? false banks" observed in meadows where breakdown, slumping, and/or fracture show instability yet vegetative cover is abundant. *Cumulative Rating 5 8 (moderate erosion)* with a corresponding lateral recession rate of 0.06 0.2 feet per year.
- Mostly uncovered and stable (vulnerable). Streambanks are less than 50% Covered as defined above. Streambanks are Stable as defined above. Uncovered, stable banks are typical of streambanks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 0.2 feet per year.*
- **Mostly uncovered and unstable (erosional).** Streambanks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding streambanks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Streambanks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

#### **Site Selection**

The first step in the bank erosion inventory is to identify key problem areas. Streambank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segment of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types).

Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and consistent geometry need less. Typically between 10 and 30 percent of streambank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property.

Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

#### Field Methods

Streambank erosion or channel stability inventory field methods were originally developed by the USDA USFS (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Field crews typically consist of two to four people and are trained as a group to ensure quality control or consistent data collection. Field crews survey selected stream reaches measuring bank length, slope height, bankfull width and depth, and bank content. In most cases, a Global Positioning System (GPS) is used to locate the upper and lower boundaries of inventoried stream reaches. Additionally, while surveying field crews photograph key problem areas.

#### **Bank Erosion Calculations**

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor. The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * ?_B]/2000 \text{ (lbs/ton)}$$

where:

E = bank erosion over sampled stream reach (tons/yr/sample reach)

 $A_E$  = eroding area (ft<sup>2</sup>)

 $R_{LR}$  = lateral recession rate (ft/yr)

 $?_B = \text{bulk density of bank material (lps/ft}^3)$ 

The bank erosion rate  $(E_R)$  is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:

$$\begin{split} E_R &= bank \; erosion \; rate \; (tons/mile/year) \\ E &= bank \; erosion \; over \; sampled \; stream \; reach \\ &\quad (tons/yr/sample \; reach) \\ L_{BB} &= bank \; to \; bank \; stream \; length \; over \; sampled \; reach \end{split}$$

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge (Leopold et al, 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50 year flood event might cause five feet of bank erosion in one year and over a ten year period this events accounts for the majority of bank erosion. These factors have less of an influence where bank trampling is the major cause of channel instability.

The  $eroding\ area\ (A_E)$  is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding. For example, the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed.

Determining the *lateral recession rate* (R<sub>LR</sub>) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates: for example, aerial photo interpretation, anectodal data, bank pins, and channel cross-sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as

surrogates for bank erosion rates. For the Lemhi River, anectodal data were used to estimate bank recession rates. Table 1 summarizes the results and recession rates are in

Table 1. Bank lateral recession rates measured in Lemhi River Subbasin using anecdotal data.

	Lateral Recession		Recession	
Site	(ft)	Time (yr)	Rate (ft/yr)	Comments
18 - mile Creek (silt-clay)	2.5	2	1.25	Bank erosion results from cattle trampling bank rather
				than stream discharge. Likely not a good measure for other streams.
Kitley Creek (clay-silt)	14	37	0.38	Fence posts exposed, Fence built in late 1950s.
				Assume 1960 for rate calculation. Two feet lost in 1997 flood event.
Geertson Creek (silt-sand)	15	52	0.29	Cedar fence built in 1945.

general agreement with the NRCS (1983) categories. Additionally, Table 2 is included to compare estimated recession rates to rates measured in recent research projects.

The *bulk density* (?<sub>B</sub>) of bank material is measured ocularly in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

Table 2. Bank lateral recession rate measured in various research projects

Reference	Average Migration Rate (ft/yr)		Comments
From Burckhardt and Todd (1998)	forested	unforested	Data collected in North Central Missouri in glacial deposits.
	0.7	5.3	Included here to show extreme values in highly
	1.9	5.6	unstable sand-gravel bank material.
	1.4	3.1	
	2.3	7	
	0.3	1.7	
	0.9	5.6	
	2.3	10.5	
	4.5	8.6	
	0.6	0.9	
From Trimble (1997)	0.65		Urbanized watershed. Sand-silt bank material
	13		

### **Gully Erosion and Mass Wasting**

Two methods were used to estimate the natural and anthropogenic frequency of gully erosion and mass wasting. First, field inventories were conducted to quantify the present level of gully formation and mass wasting occurrence. Second, historic aerial photos were used to document the spatial and temporal characteristics of gully formation and mass wasting.

The gully erosion field inventory followed methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). Much like the streambank erosion inventory technique, the direct volume method is used to quantify the amount and rate of sediment erosion and delivery from gullies.

The mass wasting inventory was conducted using similar techniques, however, because these features tend to be discrete sources of sediment the average annual sediment input was not quantified. Rather, the total volume and mass delivered to the stream channel were estimated.

Active features were surveyed using standard surveying equipment. The geometry of each feature was surveyed and sediment samples were collected. The sediment samples were sieved and weighed to quantify the cumulative grain size distribution of the sediment sources. These data are reported in Plate 9.

The aerial photos were interpreted using standard techniques described by Compton (1996). Resource aerial photos, taken by the BLM, from 1946, 1960, 1974, 1992, and 1993 were used to characterize the location of features and to quantify the approximate time of gully and mass wasting initiation. The photos were also used to characterize changes in land use, riparian cover, and bank condition where possible.

#### **Subsurface Fine Sediment Sampling**

McNeil Sediment Core samples were collected to describe size composition of bottom materials in salmonid spawning beds of streams on the 303(d) list for sediment. Research has shown that subsurface fine sediment composition is important to egg and fry survival, Hall (1986), Reiser and White (1988). Data gathered as part of the TMDL and other studies relevant to the Lemhi River Subbasin are presented in Plate 10.

#### Site Selection

Sample sites selected displayed characteristics of gravel size, depth and velocity required by salmonids to spawn and were determined to be adequate spawning substrate by an experienced fisheries biologist. Samples were collected during periods of low discharge, as described in McNeil and Ahnell (1964) to minimize loss of silt in suspension within the core sampling tube. Sample sites were generally in the lower reach of streams where spawning habitat was determined to exist.

#### Field Methods

A 12 inch stainless steel open cylinder is worked manually as far as possible, at least 4 inches, into spawning substrate without allowing flowing water to top the core sampling tube. Samples of bottom materials were removed by hand, using a stainless steel mixing bowl, to a depth of at least 4 inches and placed into buckets. After solids were removed from the core sampling tube and placed into buckets, the remaining suspended material was discarded. It is felt that this fine material would be removed through the physical action of excavating a redd and would not be a significant factor with regard to egg to fry survival. Additionally, rinsing of sieves to process the sample results in some loss of the fraction below the smallest (0.053 mm) mesh size.

Samples were placed wet into a stack of sieves and were separated into 10 size classes by washing and shaking them through nine standard Tyler sieves having the following

square mesh openings (in mm): 63, 25, 12.5, 6.3, 4.75, 2.36, .85, .212, .053. Silt passing the finest screen was discarded.

The volume of solids retained by each sieve was measured after the excess water drained off. The contents of each of the sieves were placed in a bucket filled with water to the level of a spigot for measurement by displacement. The water displaced by solids was collected in a plastic bucket and transferred to a 2,000 ml graduated cylinder and measured directly. Water displaced by solids retained by the smaller diameter sieves was also collected in a plastic bucket and measured in a 250 ml graduated cylinder. Variation in sample volumes was caused by variation in porosity and core depth. All sample fractions were expressed as a percentage of the sample with and without the 63 mm fraction.

Three sediment core samples were collected at each sample site and grouped together by fractions 6.3 mm and greater and 4.75mm to 0.53mm. The results for a particular site are the percentage of 4.75mm to 0.53mm as a percent of the total sample. Standard deviation is calculated for estimates including and excluding particles 63 mm and above.

#### **Surface Erosion from Roads**

Surface erosion from unimproved/unsurfaced roads and four-wheel drive trails considered to generally be within 50 meters of TMDL waters was estimated using numerical values from an extension of the US Department of Agriculture WEPP model. This model has been widely applied to estimate surface erosion from unsurfaced roads, particularly on USFS lands. The model is based on the gradient of the road, the distance to the stream (buffer distance), the slope angle to the stream (buffer slope), the width of the road, the soil type adjacent to the road and the amount of precipitation on the road. The assumptions used for the estimated tons of sediment produced over a particular reach of road were that the buffer slope was 25%, road width was 15 feet, distance to the stream was 30 feet, the soil or road material was gravelly loam and erosion was primarily snowmelt driven which uses an annual precipitation of 32 inches. It is likely that erosion is consistently over estimated given these assumptions within the Lemhi watershed, however the purpose is to conservatively estimate erosion load and to prioritize sources that may be having an impact on aquatic beneficial uses. It is felt that erosion estimates are a valid tool for identifying and ranking sources in which to apply reductions based on implementation of BMPs.

Segments to be evaluated were identified using 7.5 minute USGS topographical maps and orthoquad aerial photos. The distance to water was estimated using the same maps and photos. Gradient was determined using a Scale Master Plus® digital plan measure to determine road distance for each 40 foot contour interval along the road being evaluated.

Erosion estimates from the WEPP model were made for gradients of 2%, 4%, 8% and 16%. Linear regression was used to interpolate intermediate values for gradients from 1 to 44 percent. Predicted tons per mile were then applied to the various segment lengths at

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each of the observed gradients and accumulated to estimate the tons of sediment produced by each segment of Road. Tons of sediment was broken down by the distance to the stream to show the relative amount in each distance interval, even though the buffer distance was assumed to be a constant 30 feet over the road segment being estimated. The result is a conservative estimate of sediment delivered to the stream in question with an implicit margin of safety.

Stream Bohannon Creek

Section East Fork section beginning 1/8 mile above confluence of Bohannon

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Field Crew Pam Druliner BLM Jim Fitzgerald EPA Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Land Use Irrigated Agriculture/Range

Stream	Segment	Location
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			Degre	es Mi	nutes					•
GPS: Upstream	N			45	9.21					
	w			113	42.19				 <ul> <li>Control of the second of the se</li></ul>	
Downstream	N			45	8.725					
	W			113	42.95				 	
Stream Bank Erosion Calcu	ations		-							
AVE, Ban	k Height:	2.7	feet		Inv. bank to	bank length (LBB)	7200	feet	Stream Bank Eros	ion Reduction Calculations
Inventoried Eroding Seg	J. Length	3600	feet							

37 over sampled reach (E) Erosion Rate (ER) 12 27 tons/mile/year 1.7 1.7 Eroding bank extrapolation 1.7 1.7 Eroding bank extrapolation

Flow a contributing factor?: No

Other contributing factors?: Other Notes:

Total stream bank erosion

20

Total stream bank erosion

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				Control of the Contro		COMM
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GPS: Upstream	w	45 113	42.545			
Downstream	N	-45	9.12			
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Bank erosion over sampled reach (E Erosion Rate (Er		tons/mile/sample resc tons/mile/vear			Bank erosion over sampled reach (E) Erosion Rate (Ex)	8 tons/mile/sample i 6 tons/mile/year
Miles of Similar Stream Type	100	miles			Miles of Similar Stream Types	3.2 miles
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Total stream bank erosio Comments	n 290	tons/year			Total stream bank erosion	15 Itons/year
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Stream Bank Erosion Inventory Works Stream Bohannon Creek			· · · · · · ·					A Committee of the Comm		
Section Middle Reach From con	fluence of i	Fast Fork Downstream						•		
Field Crew Scott Feldhausen BLM				Data	reduced t	y Tom Herron,	DEQ			
Vince Guyer BLM						Jim Fitzgeral	d, EPA			
Land Use Grazing							2.8			
Stream Segment Location								_		
Ottoani Cognon Location		Degrees Minu	tes							
GPS: Upstream N		45	9.175							
W		113	42.1							
Downstream N		45	8.8							
W		113	42.55					_		
Stream Bank Erosion Calculations										
AVE, Bank Height:	5.8	feet	inv. bank to b	ank length (Lss)	4948	feet		Stream Bank Erosion Reduction	Calculations	\$
Inventoried Eroding Seg. Length	2474	feet								
Percent eroding bank	0.50									
Bank erosion over sampled reach (E)	88	tons/mile/sample re	each					Bank erosion over sampled reach (E)		s/mile/sample read
Erosion Rate (ER)	94	tons/mile/year						Erosion Rate (ER)		s/mile/year
Miles of Similar Stream Types	0.97	miles						Miles of Similar Stream Types	0.97 mik	38
Eroding bank extrapolation	0.97							Eroding bank extrapolation	0.97	
Total stream bank erosion	91	tons/year						Total stream bank erosion	18 ton	s/year
Other contributing factor		assume sandy gra	vel for bank ma	terial						
Other Notes: Page 2	336 July 90,44									
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#Strain and the design of the	1.00 pt.									
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percent of the east that where		13.5305 TVg	ing a service and a service and a service of the se	war in the contract of						

Stream Bank Erosion Inventory Worksheet Stream Bohannon Creek Section Lower Bohannon Creek Field Crew Pam Druliner BLM Data reduced by Tom Herron, DEQ Jim Fitzgerald EPA Jim Fitzgerald, EPA Land Use Grazing **Stream Segment Location** Degrees Minutes GPS: Upstream 45 8.55 113 42.75 45 7.8 113 43.5 Stream Bank Erosion Calculations AVE. Bank Height: Inv. bank to bank length (Lss) 12338 feet **Stream Bank Erosion Reduction Calculations** 5.3 foot Inventoried Eroding Seg. Length 3497 Percent eroding bank 0.28 Bank erosion over sampled reach (E) 210 tons/mile/sample reach Bank erosion over sampled reach (E) Erosion Rate (ER) 90 tons/mile/year Erosion Rate (ER) 10 tons/mile/year Miles of Similar Stream Types 3.1 Miles of Similar Stream Types 3.10 **Eroding bank extrapolation** Eroding bank extrapolation 1.8 Total stream bank erosion 158 Total stream bank erosion Comments Flow a contributing factor?; Yes, High flow affecting banks. Pages 1, constitution of the page \$ \$ \$ 1. Horself segment One is not differ difference of the entire designed fix outside the color of the Other contributing factors?: Other Notes: Liveria Tibras, etc. obecessiva Application of the second of the second Etwo-kassies associations genage provided

Stream Eighteen Mile Creek

Section Upper Section above corral

Consult provide basis decreases

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prometer an energy of period ordinary

Field Crew Tom Herron; DEQ Sr. Water Quality Analyst Alan Bradbury, Model Watershed Project-Project Planner Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Land Use Grazing Stream Segment Location

		Degrees Minu	tes
GPS: Upstream	N	44	30.311
	w	113	10.299
Downstream	. N	44	30.2
	w	113	11,568

Stream Bank Erosion Calculations		*					
AVE, Bank Height:	2.3	feet Inv.	bank to bank length (LBS)	13756	Stream Bank Erosion Reduction	Calculati	ons
Inventoried Eroding Seg. Length	822	feet			and the second second		
Percent eroding bank	0.06						
Bank erosion over sampled reach (E)	13	tons/mile/sample reach		-	Bank erosion over sampled reach (E)	3	tons/mile/sample reach
Erosion Rate (ER)	5	tons/mile/year			Erosion Rate (ER)	1	tons/mile/year
Miles of Similar Stream Types	23	miles	**		Miles of Similar Stream Types	23.4	miles
Eroding bank extrapolation	. 3				Eroding bank extrapolation	2.8	_
Total stream bank erosion	14	tons/year			Total stream bank erosion	3	tons/year

Comments

Flow a contributing factor?: Yes, Seasonal fluctuation results in channel migration on lower half of section

Other contributing factors? Appears heavily grazed with some side guilles forming from upland run-off.

Willow recolonization is limited by browsing cattle.

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Contract to the second second

Stream Bank Erosion Inventory Worksheet Stream Eighteen Mile Creek Section: Lower Section below confluence with Divide Creek from upper State land downstream Data reduced by Tom Herron, DEQ Field Crew Chris Mebane DEQ Jim Fitzgerald, EPA Jim Fitzgerald EPA Land Use Grazing/Irrigated Agriculture Stream Segment Location Minutes Degrees 32.487 GPS: Upstream 113 12,82 32,465 44 Downstream 113 14.473 Stream Bank Erosion Calculations Stream Bank Erosion Reduction Calculations lay, bank to bank length (Len) 17165 feet AVE. Bank Height: 2.0 Inventoried Eroding Seg. Length 2836 feet Percent croding bank 0.17 tons/mle/sample reach Bank erceion over sempled reach (E) Bank erosion over sampled reach (E) tons/mile/sample reach tons/mile/year Erosion Rate (Ex) Erosion Rate (Ex) tons/mila/year Miles of Similar Stream Types 28.1 miles Miles of Similar Stream Types 28 miles Eroding bank extrapolation 9.3 **Eroding bank extrapolation** Total stream bank erceion 11 Total stream bank erosion 47 tons/year Comments Flow a contributing factor?: No Other contributing factors?: Breached irrigation diversion above this pt. contributing sediment Other Notes: Heavily grazed

	et .				
Stream Geertson Creek					
Section Upper Reach					
Field Crew Pam Druliner BLM		Data red	luced by Tom Herron, DEQ		
Jim Fitzgerald EPA		•	Jim Fitzgerald, EPA		
Land Use Irrigated Agriculture/Pasture/	Range				
Stream Segment Location					
	Degrees Minu	ites		<del>-</del>	
GPS: Upstream N	45	11.53			
w	113	43.84			
Downstream N	45	9.93			
W	113	14.42			
Stream Bank Erosion Calculations				<del></del>	
AVE. Bank Height: 7.	.7 feet	inv. bank to bank length (Lss)	8558 feet	Stream Bank Erosion Reduction C	alculations
Inventoried Eroding Seg. Length 21					
Percent eroding bank 0.2					
Bank erosion over sampled reach (E) 48		each		Bank erosion over sampled reach (E)	26 tons/mile/sample
Erosion Rate (ER) 30				Erosion Rate (ER)	16 tons/mile/year
Miles of Similar Stream Types 3				Miles of Similar Stream Types	2.6 miles
Eroding bank extrapolation				Eroding bank extrapolation	1.3
Total stream bank erosion 38				Total stream bank erosion	20 tons/year
omments		2			
Flow a contributing factor?: No	<b>I</b> A				
Elizar Received America					
	distorio Olsose Minino	on when the form the control of the second			
Other contributing factors?: H	Historic Placer Mining	e aleganisas estas e			
Other contributing factors?: H Other Notes:		r számásárá terrők el regyől r <b>edes</b> ekező			
Other contributing factors?: H		n tueben kepa in protes protesti kinederata.			
Other contributing factors?: H Other Notes:		n speine pape i se me se en public espeine per espeine se en public espeine per en per espeine se en per espeine se en per en pe		n on the second of the second	
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Other contributing factors?: H Other Notes:	33.			Andrew States St	to the second
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Other Contributing Factors?: POther Notes:  Series		Control Control Section (Control Control Contr		Starte County Co	Reserved States of the States
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Other contributing factors?: H Other Notes:  Self of the Notes of the	A (17)  200 (19)			Starte County Co	At a second of the second of t
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Stream Bank Erosion Inventory Worksheet Stream Geertson Creek Section Middle Section below feed lot Data reduced by Tom Herron, DEQ Field Crew Pam Druliner BLM Jim Fitzgerald, EPA Jim Fitzgerald EPA Land Use Irrigated Agriculture/Grazing/CAFO Stream Segment Location Minutes GPS: Upstream Downstream Stream Bank Erosion Calculations **Stream Bank Erosion Reduction Calculations** Inv. bank to bank length (Las) 7761 feet AVE. Bank Height: 2.5 Inventoried Eroding Seg. Length 2000 0.26 Percent eroding bank Bank erosion over sampled reach (E) 2 Bank erosion over sampled reach (E) Erosion Rate (ER) Erosion Rate (ER) 1 Miles of Similar Stream Types 2.0 Miles of Similar Stream Types 2.0 Eroding bank extrapolation **Eroding bank extrapolation** Total stream bank erosion Total stream bank erosion Comments Other contributing factors?; Animal access during winter: CAFO Other Notes: Banks are in good condition however a lot of sediment deposition from animal access and early units and the "the upstream sources, respectively to a level of the second second son in a property two street When the production place of a god the Vicency glastical commissed Jage week manus are realized to a lar

Stream Geertson Creek

Section Lower Reach: EnEarl/Bolton property line down to lower Bolton property line

Field Crew Scott Feldhausen BLM

Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Vince Guyer BLM

Land Use Irrigated Agriculture/Grazing

e.	-	C	eame	mf 1	anat	inn

		Degrees	Minutes						
GPS: Upstream	N	45	8.9						
· ·	w	113	44.49						
Downstream	N	45	8.94						
	w	113	45.08				_		
Stream Bank Erosion Calculations	3								
AVE. Bank Heigh	t: 2.4	feet	inv. bank i	to bank length (LBB)	7960 fe	at .	Stream Bank Erosion Reduction	Calcula	tions
Inventoried Eroding Seg. Lengt	h 4530	feet							
Percent eroding ban	k 0.57								
Bank erosion over sampled reach (I	E) 45	tons/mile/sam	ple reach				Bank erosion over sampled reach (E)	14	tons/mile/sample reac
Erosion Rate (E	R) 30	tons/mile/year	r				Erosion Rate (ER)	9	tons/mile/year
Miles of Similar Stream Type	s 3.4	miles					Miles of Similar Stream Types	3.4	miles
Eroding bank extrapolation	n 4						Eroding bank extrapolation	3.9	_
Total stream bank arnalo	118	tonskear					Total stream bank erosion	36	tons/year

Comments

Flow a contributing factor?: Yes, diversions above and on this reach decrease flushing capacity.

Other contributing factors?: Limited animal access Other Notes:

Stream Kirtley Creek

Section Upper: from fenceline above Bennett residence upstream into placer mining approx. 2,239 ft. Original inventory reach split into upper and lower segments Data reduced by Tom Herron, DEQ Field Crew Chris Mebane DEQ

Jim Fitzgerald, EPA

Jim Fitzgerald EPA Land Use Placer Mining

Str	eam	Seg	ment	Location

		Degrees	Minutes				
GPS: Upstream	N	45	11.206 These are bou	inds for Upper and Lowe	r Reaches combined		
	w	113	47.912				
Downstream	N	45	10,995				
	w	113	48.315				
Stream Bank Eros	ion Calcula	tions					
AVE. Bank Hei	jht: 3.9	feet	bank to bank length (LBB)	3680 feet	Stream I	Bank Erosion Rec	luction Calculations
ried Eroding Seg. Len	gth 2261	feet					

nea mounid coll. conder		1001
Percent eroding bank	0.61	
n over sampled reach (E)	187	tons/mile/sample reach
Erosion Rate (ER)	268	tons/mile/year

Erosion Rate (ER) Miles of Similar Stream Types 4.0 Eroding bank extrapolation 5.0

Bank erosion over sampled reach (E)

67 Total stream bank erosion

Flow a contributing factor?: No

otal stream bank erosion 1331 tons/year

Other contributing factors?: This reach is currently being placer mined for approximately 2 miles above Other Notes: Below this reach primary use is grazing and irrigated agriculture

Stream Kirtley Creek

Section Lower: from Bennett residence upstream into placer mining approx. 2,289 ft.

Original inventory reach split into upper and lower segments

Data reduced by Tom Herron, DEQ

Jim Filzgereld, EPA

Field Crew Chris Mebane DEQ Jim Fitzgerald EPA

Land Use Placer Mining

Stream	m Segment	Location

			Degree	5	Minutes								
GPS: Upstream	N			45		11.206 The	se are bounds for	Upper and	Lower Read	ches combined			
G. C. OPT-2-11	w			113		47.912							
Downstream	N			45		10.995							
	w			113		48.315					<u>-</u>		
Stream Bank Erosion Calculations	-										Stream Bank Erosion Reduction	^alaula	Hone
AVE. Bank Heigh	t:	5.0	feet		inv.	, bank to be	ank length (LBB)	4100	feet		Stream Bank Erosion Reduction	JaiGuia	LIUIIS
Inventoried Eroding Seg. Lengt	th	853	feet										
Percent eroding bar	k	0.21										-	tons/mile/sample reach
Bank erosion over sampled reach (	E)	97	tons/mi	le/san	ple reach						Bank erosion over sampled reach (E) Erosion Rate (ER)		tons/mile/year
Erosion Rate (E	R)	125	tons/mi	le/yea								•	•
Miles of Similar Stream Gradie	nt	3.2	miles								Miles of Similar Stream Types	3.2	miles
Eroding bank extrapolation	n ·	1.3									Eroding bank extrapolation	1.3	<b>-</b>
Total stream bank erosio		166	tons/ye	ar							Total stream bank erosion	8	tons/year

Comments

Flow a contributing factor?: No

Other contributing factors?: This reach is currently being placer mined for approximately 2 miles above Other Notes: Below this reach primary use is grazing and irrigated agriculture

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Stream Bank Erosion Inventory W	orksheet									
Stream Sandy Creek (uppe								3		
Section Upper Section From	n private boundary to				an agency for New York	Contract agreement about the sent over (all each fine				
Mez≋ Fleld Crew Pam Druliner BLM		o segulation de la tradition de la companya de la c		Data reduced b	y Tom Herron, DEQ	\$ 100 miles				
Jim Fitzgerald EPA			an a sa <b>s</b> em la libraria. Salah	ranga sagaran Propinsi sagaran	Jim Fitzgerald, EPA					
Land Use Range Stream Segment Location										
Sizesir	De	grees Minutes						`	•	
GPS: Upstream	N	45	3.98							
And the	w	113	38.5							
Downstream	N	45	3.08							
New York Frederick Colonial Colonia Colonial Colonial Colonial Col	W	113	40.01							
Stream Bank Erosion Calculations  AVE. Bank Height		d for	. bank to bank leng	rth (Lss) 6336	feet	Stream Bank Erosion Reduction	n Calculati	ons		
Inventoried Eroding Seg. Lengt		-		,,, 5555				=		
Percent eroding ban										
Bank erosion over sampled reach (E		ns/mile/sample reach	<b>1</b>		The American State of the Con-	Bank erosion over sampled reach (E)		tons/mile/sample r	each	
Erosion Rate (Er		ns/mile/year				Erosion Rate (ER)		tons/mile/year		
Miles of Similar Stream Type		les		•	New Willeston	Miles of Similar Stream Types Eroding bank extrapolation	2.2 2.2	miles		
Eroding bank extrapolatio		ns/year			To words out	Total stream bank erosion		tons/year		
A service	8	iaryoai			A CONTRACTOR OF THE CONTRACTOR	A CONTRACTOR OF THE CONTRACTOR	<u> </u>	1		
Other contributing f Other Notes: Very	saturated and wet soil	is surrounding the si	ream channel	Water military						
Other Notes: Very	saturated and wet soil	Is surrounding the st	suditi .	Maria de la compania del compania del compania de la compania del la compania de la compania del la compania de	And the state of t	LENGT POP COL	gang ta a sangta sa	Margar Turker Course service.		
Other Notes: Very	saturated and wet soil	Are greatly being reflect to well at	suditi .	Maria de la companya	Andrew Salar (Salar (Sa	the contract was every		The Mark South		
Other Notes: Very	saturated and wet soll	ter gegen beef ender een een een een een een een een een e	suditi .				ei Jos	The second of th		
Other Notes: Very	saturated and well soll	Are greatly being reflect to well at	STEP		and the second of the second o	ন্ত্ৰিক ক্ষেত্ৰিক বিশ্ব কৰি । ১৯৯১ - শ্ৰেমিক ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ	4 Z	1.44.0.148,748.		
Other Notes: Very	saturated and wet sold	ter gegen territoria (s. 1923). Sandaria	STEP			acid a s. derekta hasanca disa Kanekta basa perkepakan	4 Z			
Other Notes: Very	Shutted and well soll of the soll of the s	To great ten great to a constitution of the co	STEP			ন্ত্ৰিক ক্ষেত্ৰিক বিশ্ব কৰি । ১৯৯১ - শ্ৰেমিক ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ	4 Z	1.44.0.148,748.		
Other Motes: Very	Shutted and well soll of the soll of the s	ter gegen territoria (s. 1923). Sandario	STEP		4450	ন্ত্ৰিক ক্ষেত্ৰিক বিশ্ব কৰি । ১৯৯১ - শ্ৰেমিক ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ ক্ষেত্ৰিক ক্ষেত্ৰ		eliano la proprieto. Escripción Pendelos		
Other Notes: Very	Shutted and well soll of the soll of the s		a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes: Very	Shutted and well soll of the soll of the s	To great ten great to a constitution of the co	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes. Very	Shutted and well soll of the soll of the s	In open to grand the con-	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes: Very	Control of College Col		a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes: Very	Control of College Col	The control of the co	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes. Very	The second secon		a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Other Motes: Very	The second of th		a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
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Other Motes: Very		In contact to contact the contact to	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
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Other Motes: Very		In contact to contact the contact to	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Deter Motes: Very many many many many many many many man		In contact to contact the contact to	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos		
Differ follows. Very many many many many many many many man		In contact to contact the contact to	a a de a			An angled Tower Consideration ( 2012 - 1 Ottograph Statement School School of the Statement St		eliano la proprieto. Escripción Pendelos	163	

Stream Sandy Creek (lower)

Section Lower Section on Craig Stahf's property

Field Crew Scott Feldhausen BLM Vince Guyer BLM Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Land Use Grazing/irrigated agriculture

Stream Segment Location					
Stream Segment Country		Degrees	Minut	ies	
GPS: Upstream	N		45	3,98	
GPS. Upstream	w	1	13	38.5	
Downstream	N		45	3.08	
Downsoean	w	1	13	40.01	

Downstream	N		45	3.08					
DOM: BJ OWN	w		113	40.01		_		DI SE SESSIONE	
Stream Bank Erosion Calculations AVE Bank Height		0.9	feet	lnv. bank to bank length	h (Los)	7650	feet	Stream Bank Erosion Reduction Calculations	
Inventoried Eroding Seg. Length	h	3825	feet						
Percent eroding ban		0.50						Bank erosion over sampled reach (E) 3 tona/mile/sc	ample reach
Bank erosion over sampled reach (E	3)	6	tons/mile/samp	vie reach				Erosion Rate (Ex) 2 tons/mile/y	100
Erosion Rate (Ex		4	tons/mile/yeer					Miles of Similar Stream Types 0.9 miles	
Miles of Similar Stream Type	3	1	miles					Eroding bank extrapolation 0.9	
Eroding bank extrapolatio	n	1	_					Total stream bank erosion 2 lons/year	10
Total stream bank erosio	n	3	tons/year						

Comments

Flow a contributing factor?: No.

Other contributing factors?: No. Other Notes: Very good ecological health

Stream McDevitt Creek

Section Upper; above private land

Field Crew Torn Herron; Sr. Water Quality Analyst Elton Modroo; Geologist

Data reduced by Tom Herron, DEQ

Jim Fitzgerald, EPA

Land Use Transportation Corridor

Stream Segment Location

Ottourn Ouginorit Look	itroit									<del></del>			
			Degree	s M	linutes								
GPS: Upstream		N		44	57.44								
	1	N		113	47.55								
Downstream	,	N	-	44	55.749								
	,	N :		113	45.695								
Stream Bank Erosion	Calculations		-							<del></del>			
· . A	VE, Bank Height:	7.9	feet		Inv. bank to	bank length (Les)	29062	feet		Stream Bank Erosion Reduction	on Calcula	ations	
inventoried Eroc	ding Seg. Length	10560	feet										
Perc	ent eroding bank	0.36											
Bank erosion over s	ampled reach (E)	131	tons/mi	le/sample	e reach					Bank erosion over sampled reach (E	113	tons/mile/sample reach	
	rosion Rate (ER)	24	tons/mi	le/year						Erosion Rate (En	) 21	tons/mile/year	
Miles of Simil	ar Stream Types	5	miles			• •	,		100	Miles of Similar Stream Type:	s 5 ·	miles	
Eroding ba	nk extrapolation	3								Eroding bank extrapolation	n 3.36	<u> </u>	
T-4-1-4										Total etraem bank eroelo	. 60	tonetuner	

Flow a contributing factor?: Runoff impulse is greater than stream channel available because of the road, resulting in erosion.

Other contributing factors?: Narrow canyon with scree slides and road bounding creek Other Notes: Low fall flow apparent resulting in little fisheries value, road leaves stream on upper end of reach.

Stream McDevitt Creek

Section Middle section from lower cattle crossing to lower private boundary Field Crew Torn Herron DEQ; Sr. Water Quality Analyst

Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Land Use	Grazing,	transportation corridor

Stream Segment Locat	ion							 <del>_</del>		
			Degrees Mi	nutes				·		
GPS: Upstream	N	l	44	55.749						
	٧	٠.	113	45,695						
Downstream	N	i	44	55.532						
	v	٧	113	42.682				 		
Stream Bank Erosion C	alculations									
AVI	E. Bank Height:	2.6	feet	inv. bank to	oank length (LBB)	29062	feet	Stream Bank Erosion Reduction	Calcula	tions
Inventoried Erodi	ng Seg. Length	3380	feet							
Percen	it eroding bank	0.12						· · · · · · · · · · · · · · · · · · ·		
Bank erosion over sar	npied reach (E)	291	tons/mile/sample	reach				Bank erosion over sampled reach (E)	16	tons/mile/sample reach
En	osion Rate (ER)	53	tons/mile/year					Erosion Rate (ER)	3	tons/mile/year
Miles of Simila	r Stream Types	3.48	miles					Miles of Similar Stream Types	3.48	miles
	k extrapolation	0.81						Eroding bank extrapolation	0.81	_
	n bank erosion	43	tons/year					 Total stream bank erosion	2.4	tons/year

Comments

Flow a contributing factor?: Yes, channel is constrained by road and steep canyon walls resulting in

decreased energy dissipation.

Other contributing factors?; Upper portion heavily grazed, lower section less so. Dipping Vat Rd gully.

Other Notes: Flow from Sawmill Carryon appears important because flow appears to decrease significantly above this pt. Also above this pt is timbered, N.facing slope, S aspect much scree.

: 1

#### Stream Bank Erosion Inventory Worksheet Stream McDevitt Creek Section Lower Section at Caryon Mouth Field Crew Tom Herron DEQ; Sr Water Quality Analyst Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA Land Use Grazing/Transportation Corridor Stream Segment Location Mirades Degrees GPS: Upstream 55,532 113 42,682 W Downstream 44 55,901 N 113 40.00 Stream Bank Erosion Calculations Stream Bank Erosion Reduction Calculations Inv. bank to bank length (Les) 15984 feet AVE. Bank Height: 2.5 feet Investoried Eroding Seg. Length 405 Percent eroding bank 0.03 Bank erosion over sampled reach (E) tona/mile/sample reach Bank erosion over sampled reach (E) tons/mile/sample reach 3 Erosion Rate (Ex) Erosion Rate (ER) tons/mile/year tons/mile/year . Miles of Similar Stream Types Miles of Similar Stream Types miles Eroding bank extrapolation 0.06 Eroding bank extrapolation 0.06 Total stream bank erosion 0.03 Total stream bank erosion tons/year tons/year Comments Flow a contributing factor?: Yes, because the stream is constrained by the road, erosion is intensified due to decreased energy dissipation by meandering. Other contributing fectors?. Other Notes: Steep erosive canyon with rills and side guilles present but all appear stable except deep guily adjacent to Dipping Vot rd, where alluvial fan extends to McDevitt Cr.

Stream Bank Erosion Inventory Worksheet Stream McDevitt Creek Section Dipping Vat Road gully Data reduced by Tom Herron, DEQ Fleid Crew Tom Herron:Sr. Water Quality Analyst Jim Fitzgerald, EPA Elton Modroo: Geologist Land Use Grazing/Transportation Corridor Stream Segment Location Inv. bank to bank length (Lss) 12672 feet Minutes Degrees 54.5 GPS: Upstream 43.7 113 55.25 44 Downstream w 50.5 **Gully Erosion Calculations** Total weight eroded 3267.0 since 1992 6 years Time since failure 545 tons per year Average annual erosion rate Flow a contributing factor?: Impulse flow from storm events and spring runoff drives the gully erosion here accentuated by road design and erosive soil. Other contributing factors?: Narrow, steep valley with heavily grazed slopes and reduced vegetation. Other Notes: Road erosion is evident with cultural features recently placed eroding into gully (1904), chilatemaselle, copies. 🤳 jako ka menera a menerapangan penerapangan penerapangan o la garginasti il il satari. A sa adalita partina di satura di satura di satura di satura di satura di satura Types a count hand as refer to Armidies in the entrapolation grown groupe A Danie Bebrillogue. eign or spread brech Mer-治理人 祖前侧照照证明经上部上 The state of the state of Transport Symmetry yangga gera (ga) 基本基本的特殊 医乳毒素 医皮肤性囊 建氯镍 管外 give pure experience area. YES SER ANGEL Stream Brak Crimin - Code stan Calculations gain a malaw palog tesable (1994) - 30-99 The same of the particular sections KIROLO PRILIVE WAS IN URBOT EXPERIENCE OF A CO

Stream Bank Erosion Inventory Worksheet Stream Wimpey Creek Section Upper Section: Mouth of Canyon on Jim Riggan property to mid section of his property Field Crew Tom Herron DEQ Data reduced by Tom Herron, DEQ Elton Modroo DEQ Jim Fitzgerald, EPA Land Use Grazing **Stream Segment Location** Minutes GPS: Upstream 45 7.938 40.858 113 45 7.522 Downstream 113 41.041 **Stream Bank Erosion Calculations** inv. bank to bank length (LBB) Stream Bank Erosion Reduction Calculations AVE. Bank Height: Inventoried Eroding Seg. Length Percent eroding bank Bank erosion over sampled reach (E) Bank erosion over sampled reach (E) tons/mile/sample reach Erosion Rate (ER) Erosion Rate (ER) Miles of Similar Stream Types Miles of Similar Stream Types 0.56 0.56 Eroding bank extrapolation 0.04 **Eroding bank extrapolation** 0.04 Total stream bank erosion 0.09 Total stream bank erosion 0.21 tons/year

Flow a contributing factor?. Steep narrow carryon above this site to source likely results in very flashy runoff as

evidenced by large (0.5') cobble substrate. Above this pt there is little deposition.

Other contributing factors?: Grazing is extensive, also heavy big game winter range use through out this reach

Other Notes: Reduced bank stability is exacerbated by flashy spring runoff with much recession resulting

from spring 1997's heavy runoff. Landowner states heaviest he's seen in 25 years on property.

Stream Wimpey Creek

Section Middle Section Lower reach of Riggan property

Field Crew Tom Herron DEQ

Elton Modroo DEQ

Data reduced by Tom Herron, DEQ Jim Fitzgerald, EPA

Land Use Grazing/Irrigated Pasture

			Degrees	N.	linutes					0.014015		
SPS: Upstream	N			45	7.522					0.914015		
	w			113	41.041				9652			
Downstream	N			45	6.997							
	w			113	41.571				 	•		
Stream Bank Erosion Calcu	lations					to and the month (1 pm)	8428	feet		Stream Bank Erosion Reduction Calcu	lations	
AVE. Bank	Height:	5.8	feet		inv. bank to	bank length (LBB)	0420	loot				
Inventoried Eroding Seg.	Length	720	feet									
Percent erodis	ng bank	0.09								Bank erosion over sampled reach (E)	6	tons/mile/sample reach
Bank erosion over sampled re	each (E)	96	tons/mile	/sample	reach					Erosion Rate (ER)	4	tons/mile/year
Erosion R	ate (ER)	60	tons/mile	/year							0.91	miles
Miles of Similar Stream	n Types	0.91	miles							Miles of Similar Stream Types		Hillos
Eroding bank extra		0.16				•				Eroding bank extrapolation	0.16	٦.
	534.		¬		erche water and	Control New York Control	and the second second			Total stream bank erosion	0.61	tons/year

Comments

Flow a contributing factor?: No

Other contributing factors?: excessive impation of pasture is causing large side guilles over 11% grade to creek Other Notes: less than 2" stubble height remaining on pasture.

	( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )				
tream Bank Erosion Inventory Worksheet					
Stream Wimpey Creek					
Section Middle-lower section through car	nyon				
Field Crew extrapolated from upper reach		Data reduced by To	om Herron, DEQ		
		Ji	im Fitzgerald, EPA		
Land Use Grazing/Irrigated Pasture					
tream Segment Location					
	Degrees Minutes				
PS: Upstream N					
w			6617 1.253219697		
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Downstream N					
tream Bank Erosion Calculations					
AVE. Bank Height:	feet Inv. bank to bar	nk length (LBB) fe	et.	Stream Bank Erosion Reduction Calculat	tions
	feet				
Inventoried Eroding Seg. Length	loc.	• •			
Percent eroding bank @ acc 0.04				Bank erosion over sampled reach (E)	0 tons/mile/sampl
Bank erosion over sampled reach (E)	tons/mile/sample reach			Erosion Rate (ER)	2 tons/mile/year
Erosion Rate (ER)	tons/mile/year			Miles of Similar Stream Types	1 miles
Miles of Similar Stream Types 1	miles			Eroding bank extrapolation	0.10
Eroding bank extrapolation 0.10	1	the contract of the contract o	er einter Megnetische Stehen seiner Stehen der Stehen und der Stehen der Steh	Total stream bank eroston	0.10 tons/year .
Total stream bank erosion 1	tons/year			I OLE STREET DESK STOSION	U.2 Honsyear .
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Flow a contributing factor?:	<b>数据程序</b> 图像2010			Wanginki wan i Isali	indyrink U Adelining orderlander
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্ Other contributing factors?: ু ্ত					A STAND STANDARD SAID
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Stream Bank Erosion Inventory Worksheet
Stream Wimpey Creek

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Section Lower Reach
          Field Crew extrapolated from Middle Reach
                                                                                                               Jim Fitzgerald, EPA
                     BURP scores show high unstable banks
           Land Use Grazing/Irrigated Pasture
Stream Segment Location
GPS: Upstream
Stream Bank Erosion Calculations
                                                                                                                                            Stream Bank Erosion Reduction Calculations
                                                                     inv. bank to bank length (Lss)
                     AVE, Bank Height:
        Inventoried Ereding Seg. Length
                  Percent eroding bank
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    Bank erosion over sampled reach (E)
                                                                                                                                                                      Erosion Rate (ER)
                      Erosion Rate (ER)
                                                    tons/mile/year
                                                                                                                                                            Miles of Similar Stream Types
           Miles of Similar Stream Types
                                                                                                                                                             Eroding bank extrapolation
             Eroding bank extrapolation
                                                                                                                                                               Total stream bank eroslor
              Total stream bank erosion
                     Flow a contributing factor?: No
                     Other contributing factors?:
```

### Lemhi River Subbasin TMDL

Feature Type	Number of features	Percent of total
Shallow Rotational Slide (SRS)	5	9
Debris Slide (DS)	3.4	59
Gully (GL)	19	33
Total	58	

46-L1	DS	×	
40-L1	00		
46-L2	DS	×	
46-L3	DS	×	
46-L4	DS	×	
46-L5	DS	×	
46-L6	DS	×	
46-L0 45-L7	DS	×	
140.00	DS		
46-L8		, x	-
46-n1	GL		×
45-n2	GL		×
45-n3	GL		×
46-n4	GL		×
46-n5	GL		×
60-2	GL	×	
60-3	GL	×	
60-4	GL	×	
60-5	GL	×	9
60-6	GL	×	
60-7	GL	×	
60-L1	SRS	×	6
60-L2	SRS	+	
60-L3	DS	×	7
60-L4	DS	x	Sec. + 1 - 1 - 1
60-L5	_ DS		Χ
74-L1	_ DS		X
74-L2	DS		X
74-L3	DS	X	
74-L4	DS	X	
74-L5	DS	******	X
74-L6	DS		- X
·74-L7	DS	7	Χ
-74-L8	DS	>	×
- 74-L9	- SRS -	x	
- 74-L10	DS		X
74-L11	DS		- X
74-L12	DS		X
· · · · 74-L13	DS	- · X	^ -
74-114	SRS -	- X	
74-N1	GL	^	- × -
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74-N2			- X
93-L1	- DS		Χ
93-L2			X
93-L3	SRS	ж. Х.	
93-L4 ·	03	X	
93-L5	DS		X
93-L6		т. т. т. Т. т. т. т.	+
98-L1	DS	There is the same	X
98-L2	DS	X	
98-L3	DS	- X	1
98-L4 · · ·	- DS	Х	
98-L5	DS	- · · X	
98-L6 · · ·	DS	X	
- 98-1	GL	X	90.00000
98-2	- GL	X	
95-3	GL	. X	
98-4	GL-	- X	
98-5	GL	- X	
98-6	GL	X	

Triggering Mechanism		percent
Management	37	64
Natural	21	36
Total	58	

drainage area	Mass Wasting	Nanagement	Natural Mass
(square miles)	frequency	related frequency	Wasting frequency
21.6	3	2	1

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		5.74 800	2.6	2.6	Serve A		in the same	Comprehensive sectors		
		Average	1.1 2.4	3.4	0.40	400	Service Services	Larrey to go at the services		
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## Lemhi River Subbasin TMDL

Mass Failure Survey for Wimpey Creek Watershed

Site GPS File:

Date 08/19/98 Dominant Slope: degrees Crew Herron and Fitzgerald Azimuth: degrees

Volume Estimate for deposit

									Г	
								Total		
Landslide					Approximate	Bulk Density		displaced	Delivered	Percent
Facet	BSH(ft)	Width (ft)	Area (ft2)	Length (ft)	Volume (ft3)	(pcf)	Weight (tons)	weight	weight (tons)	delivered
Crown	20	300	6000	300	1800000	90	81000	118969	65813	55
Mid	15	150	2250	375	843750	90	37969			
Chnnl										
Deposit	6	525	3150	375	1181250	90	53156			